The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

OCTOBER 1885.

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By faith we understand that the worlds have been framed by the word of God, so that which is seen hath not been made out of things which do appear.

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XUM

The Sidereal Messenger

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 4. No. 8. OCTOBER, 1885. WHOLE No. 38.

THE COMET OF 1866 AND THE METEORS OF NOVEMBER 14.*

DANIEL KIRKWOOD.

The probable recognition of several ancient returns of the first comet of 1866, together with the identification of an additional number of star-showers related historically to this comet as their source; the further confirmation of the existence of three distinct meteoric clusters all moving in the orbit of TEMPEL'S comet; and the data thus afforded for studying the structure and history of this interesting part of the solar system, afford sufficient reason for the following re-discussion of the facts now known in regard to the origin and history of the November meteors.

TEMPEL'S COMET OF 1866.

On the 19th of December, 1865, a small comet was discovered by M. TEMPEL, of Marseilles. It was generally observed till the following February; and, although an inconspicuous object, its relations to the *Earth* and *Uranus* have given it an importance equaled by few comets recorded in history. Its orbit was computed by Dr. OPPOLZER, of Vienna, who found the time of revolution to be 33.176 years. Later researches, however give 33.28 years as the more probable period. The comet

* Read before the American Philosophical Society, July 17, 1885.

seemed much smaller in 1865–6 than at any previously observed return — a fact indicative of its gradual dissolution. Its apparent magnitude, however, at any apparition, would evidently depend on the time of year at which it passed its perihelion. Comets are recorded in the years 1733, 1699, and 1399, corresponding to dates at which TEMPEL'S comet was due; but these returns are to be regarded as doubtful. In 1866 Professor H. A. Newton suggested that the comet of that year was a return of one discovered in China, August 26, 1366, and which passed its perihelion October 13th. This identity is now very generally admitted. The interval between the perihelion passages of 1366 and 1866 is 499.3 years; or fifteen periods of 33.28 years. The comet of 1266 may have been a return of the same body; the comet seen in China, September 29, 1133, was in all probability TEMPEL'S; the interval between the apparitions of 1133 and 1366 corresponding to seven periods of 33.28 years.

The comet seen in January, 868, both in China and Europe, has been regarded by HIND and others as an early appearance of TEMPEL'S comet. "In 868," Mr. HIND remarks, "at the end of January, a comet was observed under the tail of *Ursa Minor*, which moved in seventeen days almost to the constellation *Triangulum*. In China it was seen in the first moon (February) with the same right ascension as stars in *Aries* and *Musca*. I find by calculation that when TEMPEL'S comet arrives at perihelion at the end of March or early in April, it must follow this path in the heavens, being first situated at the end of January in the constellation *Camelopardus*, where, for want of conspicuous stars of reference, it might be said to be below the tail of *Ursa Minor*; afterwards moving to *Triangnlum* and *Aries*." * Neglecting the apparitions of 1133 and 1266 as perhaps more doubtful, the interval between 868 and 1366 is equal to fifteen periods of 33.24 years.

"Sometime between April and December, A. D. 69, a comet appeared." † The interval between this date and 868 is equal

* Monthly Notices, Vol. xxxiii, p. 49.
† See Chambers' Catalogue, No. ii.

to twenty-four periods of 33.28 years. Seven periods of the same length take us back to B. C. 165; nine more to B. C. 465; and two additional, to B. C. 531; at each of which epochs a comet is recorded. 465 B. C. is also the date at which the celebrated meteoric stone, called the "Mother of the Gods," was said to have fallen from the skies. The entire history includes 2396 years, or seventy-two periods of 33.28 years.

The orbit of TEMPEL'S comet approximately intersects that of the *Earth* near perihelion and that of *Uranus* near aphelion. The discovery that it is intimately related to the meteors of November 14, and the fact that one of the minor clusters of these Leonids is soon to return, give interest to a new study of the recorded phenomena.

THE METEORS OF NOVEMBER 14TH.

Professor H. A. NEWTON traced back the great showers of 1866 and 1833 to A. D. 902.* He showed that the period must be 180 days,185 days, 355 days, 377 days, or 33.25 years, and even suggested the method of determining which of the five is the true period. This important problem was first solved, however, by Professor J. C. ADAMS, of England, who found the periodic time to be about 33.25 years.

The comet's perihelion passage occurred January 11, 1866. The meteoric shower derived from the principal group, A, was observed in Europe, November 14, 1866, and the display was repeated with diminishing brilliancy in 1867, 1868 and 1869. The most dense part of the cluster passed the descending node of its orbit about November 13, 1833, and hence also early in 1867, or about a year after the comet passed the same point.

The conclusion that TEMPEL'S comet and the great meteoric cluster of 1833 move in the same orbit, and that the latter was in fact derived from the former, was reached almost simultaneously by PETERS, LEVERRIER and SCHIAPARELLI. In 1875 the present writer called attention to the fact that the dates of sev-

* American Journal of Science, May and July, 1864.

eral meteoric showers given by HUMBOLDT and QUETELET as belonging to the November stream, indicated the existence of a second cluster B, moving in very nearly the same orbit. These, with the writer's observations in 1852, are as follows:

A. D. 288, 28 September, apparition in China.
855, } 21 October each year. For particulars, see QUETELET's Physique du Globe.
856, }
1787, "On the night between the 9th and 10th of November, many falling stars were observed at Manheim by HEMMER."
1818, } 12 and 13 of November.
1820, } 12 November.
1822, } 12 November.
1823, } 12 and 13 November.
1852, 13 November. Nature, 3 June, 1875.

The best observed seem to have been those of 288 and 1787. The interval, 1499 years, is equal to forty-five periods of 33.31 years. Seventeen of these periods bring us to A. D. 855. One period from 1787.86 brings us to 1821, the middle of the series 1818–1823. Another period would give 1854 as the time for the next display, the beginning of which was seen by the writer in 1852, when seventy-five meteors were counted between two and three o'clock. The next shower from this cluster will be due about November 13–15, 1887; the display, perhaps, commencing in 1886, or even in 1885.

The third cluster, C, has been less observed and is probably less extensive as well as less dense. The dates at which the shower has been observed are as follows:

A.D. 1582, November 7. QUETELET's Catalogue.
1813, November 8. COSMOS, iv, p. 582.
1846, } November 13. Ib., p. 578.
1847, } November 13. QUETELET.
1849, } November 13. "
1879, } November 14. Observatory, Dec., 1879, p. 248, and January, 1880, p. 274.
1880, } Nov. 14. Pop. Sci. Monthly, Feb. 1881, p. 542.

These phenomena may be thus represented:

From 1582 to 1813....231 y = 7 periods of 33.00 years.
1813 to 1847....33.19 = 1 period of 33.19 "
1847 to 1880....33.19 = 1 " " 33.19 "

The respective periods of the comet and the three meteoric groups are as follows:

Tempel's comet	33.28 years.
Group A (NEWTON)	33.25 years.
Group B	33.31 years.
Group C	33.11 years.

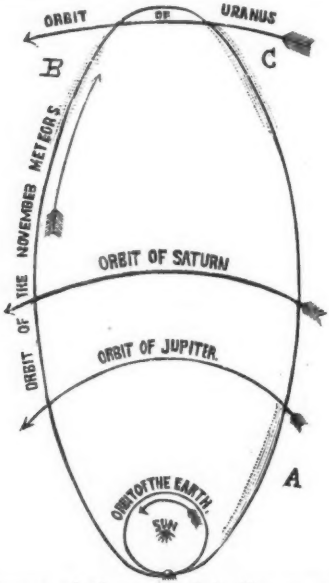
During the last five hundred years the period of Group A seems to have been rather more than 33.25 years. The meteoric display of 1366 was contemporaneous, or nearly so, with the apparition of the comet, and the complete separation of this cluster from the original mass may have then occurred. "The comet of 1866 was invisible to the naked eye; that of 1366, seen under similar circumstances, was a conspicuous object. The statement of the Chinese historian that 'it appeared nearly as large as a tow measure,' though somewhat indefinite, certainly justifies the conclusion that its magnitude has greatly diminished during the last 500 years." * Is the less apparent magnitude a consequence of separation at that epoch?

The following table affords the means of comparing the elements of the comet and those of the principal meteoric group:

	Nov. Meteors.	TEMPEL'S Comet.
Perihelion passage	Nov. 10, 1866.	Jan 11, 1866.
Longitude of perihelion	56° 26′	60° 28′
Longitude of ascending node	231° 28′	231° 26′
Inclination	17° 44′	17° 18′
Perihelion distance	0.9878	0.9765
Eccentricity	0.9046	0.9054
Semi-major axis	10.3400	10.3240
Period	33.2500 y.	33.1760 y.
Motion	Retrograde.	Retrograde.
Computer	SCHIAPARELLI.	OPPOLZER.

The orbit of TEMPEL'S comet and of the meteors associated with it is represented in the following figure, where the relative positions of the meteoric clusters correspond to the epoch of the comet's perihelion passage in 1866:

*Comets and Meteors, p. 52.



The next returns of the several bodies may be expected at the times indicated below:

TEMPEL'S comet	1899
Group A	1899 to 1901
Group B	1886 to 1889
Group C	1912 to 1915

This cometary and meteoric orbit is a connecting link between the orbits of the *Earth* and *Uranus*; the perihelion being immediately within the former, and the aphelion just exterior to the latter. All matter moving in it is liable to considerable perturbation by *Uranus* and the *Earth*, but each of the meteoric clusters is now too extensive to be much disturbed as a whole. The present writer has elsewhere noticed that about 547 B. C., just before the first recorded (probable) appearance of TEMPEL'S comet, this body and *Uranus* were comparatively near each other. *

* Comets and Meteors, p. 80.

LONGITUDE BY MOON CULMINATIONS.*

The right ascension of the *Moon* may be determined by means of a transit instrument, mounted at the place whose longitude is required, and the local time of observation compared with the Greenwich time corresponding to this right ascension, either by taking this time from the ephemeris of the *Moon*, or by means of similar observations made at Greenwich, or some place whose longitude from Greenwich is known.

COMPARISON BY MEANS OF THE EPHEMERIS.

The transit instrument having been adjusted as accurately as may be, the transit of the *Moon's* bright limb is observed, together with a number of stars suitable for determining the errors of the instrument and the clock correction. The corrections necessary to give the *Moon's* right ascension, from the observed time of transit of the limb, are then applied according to formulæ, as follows:

$$\delta' = \delta - \pi\,\rho \sin(\varphi' - \delta);$$

$$A_1 = 1 - \rho \sin\pi \cos(\varphi' - \delta);$$

$$B_1 = \frac{1}{1-\lambda};$$

$$F = A_1\, B_1 \sec\delta;$$

$$\alpha = T + \triangle T + iF + \left\{ a\,\frac{\sin(\varphi - \delta')}{\cos\delta'} + b\,\frac{\cos(\varphi - \delta)}{\cos\delta'} + \frac{c'}{\cos\delta'} \right\} F\cos\delta' \frac{S}{16\,(1-\lambda)\cos\delta'}$$

The last term of the formula may be taken from the table of moon culminations where it is given under the heading "Sidereal time of semi-diameter passing meridian."

To insure greater accuracy, the *Moon's* right ascension may be derived by comparing the observed time of transit with that of about four stars differing but little from the *Moon* in declination, two culminating before the *Moon* and two after. A list of stars suitable for this purpose was formerly given in the

* From Doolittle's Practical Astronomy as applied to Geodesy and Navigation.

ephemeris, under the heading "Moon-culminating stars," but it has been discontinued since 1882. It is an easy matter for the observer to select suitable stars from the general list of the ephemeris.

Let A_0=the right ascension of the *Moon's* bright limb at the instant of culmination;

A=the right ascension of the *Moon's* center;

θ=clock time of observed transit of limb, corrected for all known instrumental errors and for rate;

a, θ=right ascension and time of transit respectively of a star, the time being corrected for instrumental errors and rate of clock;

S_1=sidereal time of semi-diameter passing the meridian, taken from ephemeris.

Then
$$\left.\begin{aligned} A_0-a&=\theta-\theta;\\ A_0&=a+(\theta-\theta);\\ A&=A_0\pm S_1. \end{aligned}\right\} \quad - - - - - - \quad (1)$$

This quantity A is then the local sidereal time of transit of the *Moon's* centre.

We have now to take from the ephemeris of the *Moon* the Greenwich mean time T corresponding to this value A of the *Moon's* right ascension; the mean time T must then be converted into the corresponding Greenwich sidereal time θ_0. Then λ being the difference of longitude, we have

$$\lambda=\theta_0-A. \quad - - - - - - - - - \quad (2)$$

The time T may be interpolated to second differences from the ephemeris, as follows:

Let A_1=the ephemeris value nearest to A;

T_1=the corresponding time.

Then T_1+t=the required time corresponding to A.

$$A_1=f(T_1);$$

$$A=f(T_1+t)=A_1+\frac{dA_1}{dT}t+\frac{d^2A_1}{dT^2}\frac{t^2}{2}.$$

Let ΔA = the difference of right ascension for 1 minute, taken from the ephemeris;

δA = difference between two consecutive values of ΔA. δA then equals the change in ΔA in one hour. Then if t is supposed expressed in seconds, we shall have to second differences inclusive,

$$\frac{dA}{dT}=\frac{\Delta A}{60}; \qquad \frac{d^2A}{dT^2}=\frac{\delta A}{3600};$$

$$A=A_1+\frac{t}{60}\left\{\Delta A+\delta A\cdot\frac{1}{2}\cdot\frac{t}{3600}\right\}.$$

From which $$t=\frac{60\,[A-A_1]}{\Delta A+\delta A\dfrac{t}{7200}};$$

and with sufficient accuracy,

$$t=\frac{60\,[A-A_1]}{\Delta A}\left\{1-\frac{t}{7200}\frac{\delta A}{\Delta A}\right\} \quad - - - \quad (3)$$

Writing $$x=\frac{60\,[A-A_1]}{\Delta A}, \quad x''=-\frac{x^2}{7200}\frac{\delta A}{\Delta A},$$

then (3) becomes $$t=x+x'' \quad - - - - - - - - \quad (4)$$

Example. Among the observations of the *Moon* made at Washington I find the following:

1877, May 23d. Observed right ascension of the *Moon's* centre, $A = 13^h\ 28^m\ 5.02^s$

From ephemeris of the *Moon*, $T_1=14^h$, $A_1 = 13\ 27\ 3.91$

$\Delta A=2.0996$ $\qquad A-A_1 = \quad 1\ 1.11$

$\delta A=+.0029$ $\qquad 60\,(A-A_1)=3666.6$ $\qquad$ log. $=3.56426$

log. $\Delta A=$ .32213

$x=29^m\ 6.4^s$ $\qquad$ log. $x=3.24213$

$x''=\quad -.6$ $\qquad$ log. $x^2=6.48426$

$t=29\ \ 5.8$ $\qquad$ log. $(-\delta A)=7.46240_n$

ac log. $\Delta A=9.67787$

ac log. $7200=6.14267$

$T_1+t=14^h\ 29^m\ 5.8^s$

log. $x''=9.76720_n$

This is now the Greenwich mean time corresponding to the Washington sidereal time A. In order to compare the two T_1+t must be converted into sidereal time.

$$T_1+t=14h\ 29m\ 5.8s$$

Table III, Appendix N. A.,	2 22.77
Sidereal time Greenwich M. N.=	4 4 48.56
Greenwich Sidereal time θ_0=	18 36 17.1

$$\lambda=\theta_0-A=5h\ 8m\ 12.1s,$$

the required difference of longitude.

If the ephemeris were perfect, very little could be done further in the way of perfecting this method. The errors of the ephemeris, however, are not inconsiderable, and in consequence it cannot be used directly as above, except when an approximate value of the longitude is sufficient. For the year 1877 the average correction to the right ascensions of the ephemeris, as derived from 66 observations at Washington, was $-.31s$, which would have produced an error of $8s$ in the longitude if the observations had been used for that purpose.

Either of two different methods may be used for eliminating from the result these errors of the ephemeris.

First Correction of the Ephemeris. This method is due to Prof. Peirce.* The ephemeris is compared with all available observations of the *Moon* made at Greenwich, Washington, and other fixed observatories during the lunation, and in this way a series of corrections to the ephemeris obtained which, as they depend on all available data, are much more reliable than simply the place of the *Moon* observed at any one observatory.

Peirce found that for each semi-lunation the corrections to the right ascension of the ephemeris could be represented by the formula

$$X=A+Bt+Ct^2; \quad - - - - - - - - \quad (5)$$

X being the correction required, t the time reckoned from any assumed epoch (which should be chosen near the middle of the

*Report of U. S. Coast Survey 1854, p. 115 of Appendix.

period under consideration for greater convenience), and A, B and C being constants determined from the observations made at Washington, Greenwich, etc The ephemeris when so corrected is used as already explained.

Second. Corresponding observations. The difference in the longitude of any two points may be found by comparing the values of the right ascension of the *Moon* observed on the same night at both places.

The times of transit of the *Moon's* bright limb and of the comparison stars are observed at both places and the corrections applied as already explained to find the right ascension of the centre at the instant of transit. It will be a little better if the same comparison stars are used at both stations.

Let L_1 and L_2=the assumed longitudes of the two stations;*

λ=the true difference of longitude;

A_1 and A_2=right ascensions of *Moon's* centre from observations at L_1 and L_2;

H=variation of right ascension for one hour of longitude, while passing from meridian of L_1 to that of L_2.

Then $$A_2 - A_1 = \lambda H;$$

$$\lambda = \frac{A_2 - A_1}{H} \quad - - - - - - - \quad (6)$$

H is taken from the table of moon culminations, where it is given for the instant of transit of the *Moon's* centre over the meridian of Washington. When used as in (6) its value must be interpolated for a longitude midway between L_1 and L_2.

PHOTOGRAPHING THE SOLAR CORONA BY A NEW METHOD.

In photographing an object of such intense brilliancy as the *Sun*, a formidable drawback to some researches is found in the diffuse reflection from scratches or dust on the speculum or object-glass employed. When photographing Sun-spots or

*Reckoned from Washington or Greenwich according as we use the ephemeris computed for Washington or Greenwich. One of the longitudes, L_1 or L_2 must be known with some accuracy.

other well-defined markings a little false detail is not of very much consequence; but when our object is to separate the corona from the atmospheric glare, false detail cannot be permitted at all. I believe an efficient remedy for this evil is to use "nature's own camera—a minute hole in a screen.

I have this method under trial, and will shortly commence daily photographs of the corona. These will be of interest in connection with those about to be made at the Cape of Good Hope by Mr. C. Ray Woods. T. S. H. Shearmen.

August *Observatory.*

Observation on the Aurora Borealis. Made at Beloit, Wisconsin by John Tallock, Jr.

The times given are expressed in the mean time of the 90th meridian. (Central Standard Time.)

September 13, 1884.

9*h*	0*m*.	Brilliant aurora. Bright arch extending at its highest point to an altitude of about 12°. Dark cloud beneath arch.
10	30	No aurora visible
11	0	Faint light in north.
12	0	More as it was at 9*h*.

September 17, 1884.

7	30	Brilliant aurora. Arch about 12° in altitude. Dark cloud beneath.
10	5	The arch is lower, more brilliant, and in the western extremity there are streamers flashing up to an altitude of 35° or 40°.
11	10	The arch is fainter.
11	20	There are more streamers, directly in the north, and there is a belt of auroral light extending across the sky. It touches the western horizon and reaches to within 40° of the eastern. Passes about 5° south of the zenith and is about a degree wide.
11	30	The belt of light reaches clear across the sky and now touches the horizon in the east.

NOVEMBER 17, 1884.

9 15 Auroral light on north horizon. Low, seen through clouds.

FEBRUARY 5, 1885.

7 0 Bright auroral light on north horizon. Seen through clouds.

FEBRUARY 11, 1885.

10 0 Very bright aurora. Band of light along north horizon about 10° high. Western end partially obscured by clouds. At eastern end there is a streamer stretching up about 25°.

12 15 Aurora is still visible and apparently of about the same degree of intensity, but the clouds are thicker and cover more of the sky.

13 35 The light has entirely disappeared. Sky perfectly free from clouds.

MARCH 14, 1885.

12 0 Line of auroral light above north horizon. No arch or streamers. Dark cloud beneath.

MARCH 15, 1885.

8 35 Very bright aurora. Cannot make out full extent on account of clouds, but light reaches to an altitude of certainly 30° and extends farther than usual towards the east and west points.

9 18 There is a rift in the clouds at an altitude of 15°—20°, and I think that the light is decreasing.

10 12 Sky entirely overcast.

MARCH 20, 1885.

10 18 Faint diffused auroral lights on north horizon.

MAY 11, 1885.

10 48 Same appearance as on March 20th.

13 15 Lighter, still visible, same as seen at first.

HOOSAC FALLS, N. Y., August 10th, 1885.

SUN SPOTS FOR JULY 1885.

R. HENRY FERGUSON.

The *Sun* has been observed throughout July each day except on the 1st 14th, and 30th, when clouds obscured the disc.

Number of days on which the *Sun* was observed	28
Total number of groups of spots.....	82
" " " spots.....	339
Probable number of groups	90
i. e. iucluding those probably on the *Sun* the three cloudy days.	
Probable number of spots	371
Largest number of spots any one day (20th, 21st, 22nd)..	24
Smallest " " " " " " (24th, 25th, 26th)..	4

Largest spot on *Sun* from the 18th to 30th having a diameter of about 34″, or about sixteen thousand miles.

The spots this month showed about the same interesting facts as those of any previous month when an equal number of spots was visible. Among these worthy of note are the very rapid and extensive changes in both position and contour of the spots in three of the groups observed July 2nd and following days. When first seen they formed three distinct, irregular groups. On the third they had drawn nearer together. On the 5th they were arranged in three parallel lines extending north and south, having respectively two, three and four spots, with several very minute spots between the pairs forming the line of four, the most southerly. On the 6th these spots were so near together as to form only one group with only four medium sized spots, one at each angle of a square enclosing many smaller spots into which the other spots had been resolved, most of them lying between the two largest spots, the two southerly ones. On the 9th they formed one very irregular group, one large spot preceding and one medium following, attended by several small and very small spots. The 11th brought another change, for the group was then on the western limb, and exhibited two very interesting phenomena, confirming the "saucer shape" of the spots and otherwise aiding the cy-

clonic theory. On the 11th at 1^h 30^m the large spot of this group was exactly on the western limb and a very marked indenture of the limb was visible where the spot had disappeared, while the spot next in size was very near the limb and gave a more marked concave appearance than I ever before observed. The penumbra on the western side was very marked, that on the northern and southern sides was compressed into a mere line and that on the eastern side was wholly invisible, the edge of the bright portion of the *Sun* being in strong contrast with the umbra.

The large spot which appeared on the eastern limb of the *Sun* about sunrise of the 18th showed also this phenomenon of perspective. The penumbra of this spot was very clearly defined on the sides nearest the limb when entering and disappearing was waning on the opposite side and at the intervening positions was very regular in width and with the spot underwent no appreciable change during its twelve days' stay, except on the 24th, when a crescent of flake white about $10''$ in length, and three in breadth, appeared on the southerly side between the penumbra and umbra, and having a triangular horn or tongue of about $4''$ length, projecting into the umbra.

On the 25th at 4^h 32^m this phenomenon of the white crescent had disappeared.

The 31st brought two new groups of spots quite irregular and poorly defined, completely defying any good observation. With all powers they appeared as spots out of focus and to-day are still visible, presenting the same indistinct outline. All the spots visible this month appeared in groups, except the large one mentioned above (18th–30th); no attendant spot being detected, although carefully sought. Very brilliant faculæ were seen on the limbs between the 15th and 19th.

It is here impossible to enter into any more minute description of the above spots, or even to consider the sun-spot theories in general which the observations of these spots for July would suggest, and in answer to many questions as to what are sun-spots reference may be made for brief descriptions to the work of Dr. YOUNG, entitled "The *Sun*," also to the shorter

works of Rev. T. W. WEBB, "The *Sun* and His Phenomena," and the article "The Spots on the *Sun*," Art. 1, of the New Astronomy by Prof. LANGLEY in *The Century* for September, 1884.

Those who wish to know in a word what the astronomical world consider sun-spots will find it in the following words by Prof. LANGLEY: "We must conclude that the question as to the cyclonic hypothosis cannot yet be decided, though the probabilities fron telescopic evidence at present seem to me on the whole to favor M. FAYE'S remarkable theory." (i. e., that on account of the varying depth of the stratum from which the gases forming the bright surface or photosphere ascends equatorial currents are formed, eddies, cyclones, or "whirls" result, resembling whirlpools in the ocean or "whirl"-winds in our atmosphere and the funnel-shaped vortices thus formed are the spots, the centre being the umbra and the descending sides the penumbra as noted above) which has the great additional attraction to the student that it unites and explains numerous other quite disconnected facts.—*Roxbury Advocate.*

THE NEW STAR IN THE NEBULA OF ANDROMEDA.

E. E. BARNARD.

A telegram from Prof. PICKERING was received here on the evening of September 1st, announcing the discovery of a star-like nucleus in the great Nebula of Andromeda by HARTWIG. That evening, though cloudy, allowed frequent observation of the nebula through breaks in the clouds. The first glimpse through the telescope showed at once the bright stranger beaming forth in the midst of the nebula. It was a bright eighth magnitude star — perfectly stellar — of a slight yellowish cast. The light from this object was quite intense and very steady. Upon the application of high powers it retained its star-like form as distinctly as did the neighboring stars. The object illuminated the nebulosity surrounding it like a star shining through fog. With the higher powers I noticed that the nebulosity close following and slightly south was brighter; there

appeared at that point a stronger condensation of the nebula light. The star was perfectly central. [I imagined it slightly south of the middle.] On September 2nd it was suspected to be slightly brighter, though from the interference of clouds on the 1st, preventing a fair observation, any slight change could not have been certainly distinguished. On this last date a sketch of the stars in the neighborhood of the new object was begun for reference in detecting changes of its brightness. On September 3rd it was certainly not brighter; but its light was whiter. On the 4th no decided change was noticeable. So far the light of this object has presented a steady radiance with

NEBULA OF ANDROMEDA.

a is the position of the new star.
b, less bright than new star } New star midway between brightness of them Sept. 3.
c, brighter than new star }
d, as bright as new star Sept. 3.5. Many bright and small stars omitted.

no rapid fluctuations. On the 3rd for a space of a few seconds the star appeared considerably brighter, then resumed its original appearance. I think that this was deceptive and place no confidence in it though it may not be improper to state the observation so that it may be confirmed. This supposed change occurred at about midnight.

I enclose the foregoing quite incomplete sketch which will be finished at the first favorable opportunity. It will aid in tracing any changes of light in the new star that will likely occur.

It may not be out of place to state that I have always seen this nebula differently from that which other observers have delineated.

If your engraver will faithfully produce the sketch I will call attention to the main objects wherein my view differs from what I have seen sketched elsewhere. This nebula does not have the pointed ends so commonly shown in drawings of it. At both the *p.* and *f.* ends there is a brushing out or diffusion of the nebulosity toward the south, extending nearly a half degree from the main axis.

I have also detected a small, faint, but perfectly distinct nebula involved in the preceding end of the large nebula as shown in the sketch. I have seen this latter object many times, both with 5 and 6-inch aperture, and can find no record of it elsewhere.

There is a long faintish ray passing parallel to the north side of the nebula, but distinctly separate; this is one of the objects detected by BOND, I presume. There are several other features that will be shown in a drawing I am preparing to make of this very wonderful object. The northern side of the nebula is the best defined, the south side differing very much, especially at the ends.

In reference to the new star in this great nebula, I wish to put forward the claim for a gentleman in Texas who saw this star-like object on the night of August 30th at 9*h*.

On the evening of September 3rd I received a letter [postmark Aug. 31] from Mr. H. S. MOORE, of McKinney, Texas, dated Aug. 31st, 1885, in which he says, " * * * * Last night was the first good night and after failing to find the comet [*a* 1885] I turned my tube [3 5–16-inch refractor] to the N. E. on the great oval nebula of *Andromeda* and was much surprised to see at 9*h* a 6½ or 7 magnitude star nearly central in this nebula." My impression is that HARTWIG's observation was on Aug. 31st, if so, Mr. MOORE saw it first. Mr. MOORE's observation is of great interest for if he has correctly

estimated the magnitude of the new star on Aug. 30th, it was then brighter by a magnitude or a magnitude and a half than at present.

Speculations on the new star at present would be quite premature, but from my observations it seems quite clear that the star is *in* the nebula or on the other side of it, certainly not on this side, inasmuch as it illuminates the nebulosity by the transmission of its rays through it. I am aware that the star is shining in the brightest part of the nebula, but from my recollection of the original appearance, the nebula was not so bright at this point previously.

VANDERBILT UNIVERSITY OBSERVATORY, Sept. 5, 1885, Nashville, Tennessee.

THE VISIBLE SHADOW OF THE EARTH.

JOHN HAYWOOD.

We say we see the shadow of an object when the object intercepts the light of a luminary from a part of a surface, so that the surface is in part illuminated, and the eye notes the contrast between the light and dark parts. In this way we see the shadow of the *Earth* on the *Moon* when the latter is partly immersed in the shadow of the former.

We can also under favorable circumstances see the shadow of the *Earth* projected into the illuminated atmosphere, that is upon the sky. But to get sufficient depth to the shadow, and a sufficiently well-defined boundary between the shadow and the bright sky to be seen distinctly, the eye must be in or near the surface of the shadow; so as to see the shadow in its greatest intensity, and also see the unobscured bright sky.

To analyze the subject somewhat mathematically: The portion of the surface of the *Earth's* shadow within the atmosphere, and at the same time within the range of sight of the observer is to be considered sensibly a plane. This plane is tangent to the *Earth*, and as it contains the eye of the observer is a great circle of the visible sphere, and coincides with the horizon. In this case, the shadow is below the horizon, and of

course invisible; and the *Sun* is in the horizon, that is, is just rising or setting. But if it is below the horizon not more than about two or three degrees and the eye directed to the opposite side of the horizon, the line of sight makes a small angle with the shadow surface; but if the air is very clear, and the horizon is not too much obstructed by hills or forests, the shadow may be very distinctly seen. We will still consider the plane of the surface of the shadow a great circle though it passes a little above the center of the sphere, that is, the eye of the observer. Therefore as it now does not coincide with the horizon, the two great circles include between them a lune of the sphere, the breadth or angle of the lune being equal to the distance of the lune below the horizon. This lune is a visible part of the shadow of the *Earth*. When seen under favorable circumstances, it presents the appearance of a low dense cloud lying along the horizon opposite to the *Sun*. Let us suppose the time to be morning, a few minutes before sunrise, and the air to be very clear, and the western horizon to be unobstructed. We look in that direction and see a low black cloud lying along the horizon, extending well toward the north and south; and perhaps being nearly a complete lune. The shadow is identified by the evenness of its upper edge, and by its extent. Its character is proved still further, as we watch it, by its becoming narrower and more intense; the definition becoming more distinct as the shadow plane comes down nearer to the eye; thus approaching coincidence with the horizon. And then it disappears as the *Sun* begins to illuminate the western horizon, and we see there is no cloud then.

The same appearances in reverse order present themselves in the evening under like conditions. First after the *Sun* has set, there is an appearance like a dark cloud seen along the eastern horizon, having a moderately well-defined upper edge, being a narrow lune. The cloud rises as the *Sun* sinks lower; but we notice that the sharpness of the definition diminishes rapidly as the lune increases in the width; in other words, the shadow

seems to be shaded into twilight, and pretty soon we find we have lost the boundary between the shadow and the illuminated sky. Next twilight ends, and we are in the shadow of the *Earth;* but we do not now see the shadow. I have followed the shadow in the evening to a height of eight or ten degrees, but in such cases the border is very ill-defined.

I think this phenomenon should be more striking at sea, provided the atmosphere is clear enough; as the visible shadow would be, with a perfect horizon, a perfect lune. Also if seen from the summit of a high elevation, as a mountain top, from which the dip of the horizon is great enough to be sensible; the phenomenon should be still more striking; as the dip would, by so much augment the breadth of the shadow lune, as it is seen from sea level. It is interesting in this connection to notice more particularly the disturbing effect of clouds and mist and smoke in the air. At first one might think that the more opaque air would show the shadow better. But in fact it totally destroys the definition. It arises from this; that in this case there is a lack of suitable illumination of the air; there is not the bright sky to contrast with the shadowed sky. Clouds destroy the visibility of the shadow by covering and confounding the shadow, and by obscuring the bright sky.

I have wondered if this phenomenon has not been noticed by scientific observers, and been mentioned by them. Likely it has; but it has been my fortune to find a description of it nowhere except in WILLIAM BLACK's "Green Pastures and Piccadilly." His party are journeying across our western plains by railroad, when he notices the phenomenon and explains it correctly. But why has he not observed the same in England, and more especially on the Atlantic during his voyage? I am not sure I can give a correct answer to this question, as I have never been in England, nor on the sea. But I conjecture that the phenomenon, even if visible, can easily be overlooked in a hilly country on account of the obstructed horizon. And on the ocean clouds and mists may have obstructed the view. Prof. MENDENHALL once told me that he had seen an account of observations by some one on the ocean, who had noticed the shadow and had explained it.

I always call the attention of my classes in astronomy to this subject; and some of them have afterwards reported to me some specially favorable views they have had of it.

EDITORIAL NOTES.

The new star, or star-like nucleus, which has recently appeared in the great nebula of *Andromeda* is a wonderful celestial phenomenon. It was first seen, in this country, so far as we know, by J. C. McCLURE. an amateur observer of Red Wing, Minnesota.

In a private letter bearing date August 31st, Mr. McCLURE says: "Please look at the nebula of *Andromeda*. The star in the center I never saw until last Saturday night." The date of his first observation was then August 29th.

Dr. HARTWIG'S observation of the same object at Straasburg was reported, by telegraph, in America Sept. 1st. On the same day its spectrum was observed at Princeton and reported to be continuous. W. H. NUMSEN, of Baltimore, also saw it Sept. 1st. One day later Professor PICKERING, of Cambridge, secured a series of spectroscopic and photographic results, which have not yet been published.

The place of this new object was reported by an observer to be 13″ west of the old nucleus. We are not aware that this measure has been verified by any other astronomer. It was early reported, as about the 7th magnitude in brightness. September 15th it was nearly as bright as the 6th magnitude, for it was seen by two observers without optical aid. Later observations seem to indicate a decline in luster.

Observation does not yet decide whether the phenomenon is a newly developed nucleus belonging to the nebula, or a new or temporary star less distant than the nebula and in the same line of sight. Whatever the object is. it will be studied with deep interest.

COMET BROOKS.

The new comet discovered by me in *Canes Venatici* on the evening of August 31st has been observed almost nightly with the 9-inch reflector. No very marked change has taken place in the appearance of the comet, except that it has grown somewhat fainter. It is nearly circular in form, with very slight central condensation. The entire coma is very flashing at times. On September 10th the comet was observed to pass almost centrally over an 8th-magnitude star one and one half degrees north of Gamma in *Bootes*. The light of the star was not dimmed.

WILLIAM R. BROOKS.

RED HOUSE OBSERVATORY, Phelps, N. Y., September 14, 1885.

NEW STAR IN ANDROMEDA.

I obtained an observation of this wonderful object on the evening of September 2nd. It appeared to me then almost of the 6th magnitude and was distinctly seen by the naked eye. All powers of the telescope

gave a hard, well-defined nucleus. In later observations it has seemed to me somewhat fainter than at first. I notice that most observers with refractors call the star reddish. To me with the silvered-glass reflector it has always seemed of a pale greenish tint. WILLIAM R BROOKS.

RED HOUSE OBSERVATORY, September 14, 1885.

THE NEW STAR IN ANDROMEDA NEBULA.

In reference to this wonderful object I have written to Mr. H. S. MOORE, of McKinney, Texas, and he has forwarded to me his original observations of August 30th, 1885. In answer to inquiry as to his familarity with star magnitudes, he says:

"I answer that I am not well posted on magnitudes of stars, and that on the second observation I felt sure I had overstated the magnitude in my letter to you * * *. I remember that my finder, about ⅞ in., had never shown the star. * * * * On last night (7th Sept.) 50 required more careful focusing to show the star than on previous nights. One hundred has shown it plainly all the time. * * * The star seems much larger than the companion to Sigma *Scorpionis* and is an easier object and has been at every observation since the 30th [August]."

The original observations of Mr. MOORE, which he has kindly sent me without alteration or correction, state: "August 30th 9 p. m. Saw 6½ or 7 magnitude star in *Andromeda* nebula. Believe it to be new in this place. Nearly central in nebula. Aug. 31st. Saw it again, no change. Sept. 1st, 2nd and 3rd. No change. Cloudy interval. * * * Sept. 7th * * observed star again, not a good night, but I feel sure it is diminishing. * * *"

From these observations we may justly infer that the star was not sensibly brighter on August 30th, 1885, than on the few succeeding evenings. E. E. BARNARD.

SMALL NEBULA INVOLVED IN PRECEDING END OF GREAT ANDROMEDA NEBULA.

I have found a small pretty faint nebula in

$$\left.\begin{array}{l}\text{R. A.} = 0^h\ 34^m\ 16^s \\ \text{Decl.} = +40^\circ\ 5'\ 59''\end{array}\right\} 1885.0$$

It is involved in the extreme p end of the great nebula of *Andromeda*. It lies a little south of three small stars that form a triangle.

This nebula has been seen frequently with the 5-inch telescope during the last two years, but I could never be certain of its being a distinct separate nebula until lately examining the object with the 6-inch, when it was seen to be a well-defined but faint nebula. I find no record of this having been seen by any one else. E. E. BARNARD.

August 5th at 5 p. m *Jupiter* and *Venus* were both seen at once in the field of the telescope, the two planets being about 35′ apart. J. R. H.

The Secretary of the Treasury is said to have sketched out a plan to further eliminate, as far as possible, opportunities for irregularities such as have been discovered in the coast survey and are believed to exist in some of the scientific bureaus, which is to ask congrsss to authorize the creation of an executive committee or advisory board in each scientific bureau, which board or committee shall have charge of all details, such as appointments outside the scientific staff, designation of duties of employes other than those of said staff, apportionment of salaries, and supervision of the accounts of disbursing officers. Such legislation will leave the heads of these bureaus, free to spend their whole time in advancing science. It is also a part of his plan to ask that power be given the president to appoint annually a board of independent experts in science, who shall examine the scientific workings of the department or bureau and approve the same before the estimates for the work for the ensuing fiscal year shall be incorporated into the book of estimates.—*Chicago Tribune.*

Barnard's Comet.

My last observation of Barnard's Comet was on the evening of Sept. 2nd. I consider it the faintest object ever seen at this observatory though some of my new nebulæ are about equal to it in faintness. I set my telescope according to Prof. Egbert's ephemeris, being quite sure I had it somewhere in the field. It required 20 minutes of intense looking before I could positively assert that I saw anything at all. It was almost in the center of the field. I had no time to get its position very exactly as I wished to verify Brook's discovery of a comet, not knowing how long it might take. I made the position of Barnard's comet as follows: R. A. $16^h\ 27^m\ 0^s$. Dec. $-30°\ 30'\ 45''$. Not corrected for refraction in declination. LEWIS SWIFT.

Warner Observatory, Sept. 8, 1885.

Notes on the Nebula of Andromeda.

Sept. 1: Central nucleus exceedingly distinct and equals about $5\frac{1}{2}$ magnitude.

Sept. 2: Star the same, and a portion of the nebulous matter around the star seems brighter than formerly, as if illuminated additionally to the star's light.

Sept. 3: No change.

Sept. 9: Star less brilliant, having a dull cast.

Sept. 11: Star is fainter than when first seen; equals a $7\frac{1}{2}$ magnitude.

Sept. 14: Star decidedly fainter, below 8 magnitude, is a small point, showing more of the apparent disk as heretofore.

Sept. 15: Apparently about 9 magnitude. J. R. H.

THE TITLES OF CONTRIBUTIONS TO ASTRONOMICAL PERIODICALS.

A whole volume might be written on the *mechanics* of literature in general or of astronomical literature in particular. One of the most important chapters might be devoted to the rules which should be followed in giving the title to a particular book or paper. As examples of bad titles we might quote two famous books, one by HAUSEN.

"Ausseinander setzungeiner zweck massigen Methode zur Berechnung der absoluten Storungen der Kleinen Planet en," and the other by ALBERS—"Abhandlung neber die leichteste und bexuemshe Methode die Bahnlines Cometen zu benechen."

Each of these titles sins against brevity and attacks human life, and other worse ones might easily be found and the chapter written at fever heat. But the object of this note is to enter a protest against a worse style of title than this, even.

These titles are definite enough when you get through with them, and exactly express the intention of the essays, although not in the best and briefest manner. At the worst you can invent a kiud of technical name and speak of "HANSEN'S Anseinander setzung," just as one says "CRELLE" for CRELLE'S tables. But for many years there has been a kind of nebulous title floating about, especially in the *Astronomische Nachrichten* which may be described in the language of the elder HERSCHEL as

e e e diffused and difficult nucl ? ? ?

This is Auszug aus ein Schreiben von Herrn Professor Dr. ***** au deu Herausgeber."

What we wish of a title is that it shoud be

S. C. B. S. M. B. M,

and we respectfully ask that the above nebulosity should be attached to some solid mass as "betreffeud sigma 1494, sigma 1801, partielle Sonneufinsterniss von Marz 16, 1885 etc." to quote the most recent example.

Any one who has tried to index any portion of the *Nachrichten* will appreciate the force of this request, and the Editor is humbly asked to consider this one improvement to his journal. There are not many others left to make. X. Y. Z.

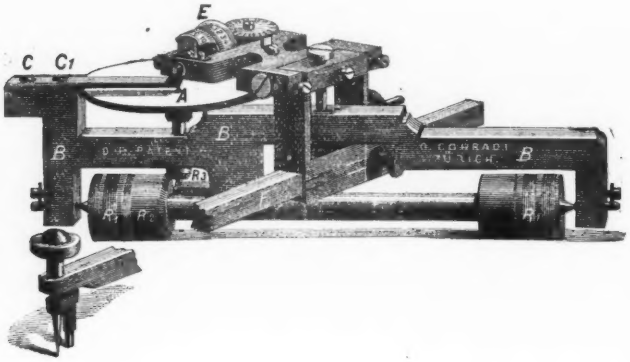
ROLLER PLANIMETER.

This instrument has been very much perfected of late, and especial attention is asked to it as the most accurate one now in use. It is more exact than all other similar instruments. The roller does not run directly on the paper, but on a perfectly flat disc, and, consequently, the results of the instrument are in no wise affected by the nature of the paper. The rotation of the roller is ten to twenty times smaller than that of the Amsler Planimeter with equal length of tracing-arm.

This new Planimeter has been described in all the leading engineering

papers in Europe, and we have no doubt but that it will be welcomed by every engineer in this country who desires a really first-class instrument.

By consulting Messrs. FAUTH & Co.'s Catalogue of Astronomical and Engineering Instruments a full description of this new and useful instrument may be found.



RECENT DISCOVERIES.

New minor planet No. (249) was discovered, August 17, by Dr. C. H. F. PETERS, Clinton, N. Y., Aug. 16.608, Wash. M. T.

R. A. $21^h\ 58^m\ 40^s$;
Decl. $-15°\ 51'$. 12 magnitude.

Star like nucleus in the nebula of *Andromeda*. Seen August 29 by J. C. MCCLURE of Red Wing, Minn. Aug. 31 by Dr. HARTWIG, of Dorfset, Russia.

Comet (BROOKS) discovered Sept. 1 by W. R. BROOKS, Phelps, N. Y.

R. A. $13^h\ 20^m$; } Rough position.
Decl. $+37°$. }

Ninth magnitude. Circular nebulosity of 2′ in diameter. Some central condensation and no tail.

New minor planet No. (250) was discovered by PALISA of Vienna, September 3. At 9^h and 53^m of the same day, Gr. M. T., its position was,

R. A. $23^h\ 34^m\ 40^s$;
Decl. $-16°\ 9'\ 35''$. Eleventh magnitude.

Merope Nebula.

On the morning of August 17 last, while waiting for Tuttle's comet to get above the horizon, the sky being very dark, I examined the *Pleiades*, and could see the faint light in the region about the star *Merope*. The general outlines can be made out by slowly moving the telescope about; when the contrast with the surrounding darker sky becomes very evident.

The failure to see this very interesting object might be attributable to a sky not transparent enough, though seemingly so.

I used a 5-inch Clark refractor, power 45, with which I once before saw the nebula, and have failed to see it on other occasions. J. R. H.

R Coronæ.

This star which is very irregular in its fluctuations, and sometimes for years remaining nearly constant in light, is at present quite faint, and is evidently undergoing one of its rare downward fluctuations. It is at present about 7.0 magnitude and should be closely followed by variable star observers. Position for 1870 is

R. A. $15^h\ 43^m\ 13^s$.
Decl. $+28°\ 33.5'$.

It changes from 6 magnitude to 13 magnitude. E. F. SAWYER.

I entirely agree with Mr. Burnham's remarks on the question of "Small *vs.* Large Telescopes" in the Sidereal Messenger for September, 1885. Edward S. Holden.

The *Science Observer* announces the observation at Nice, of Tuttle's comet, giving the following position, August 9.6124 Gr. M, T.

R. A. $7^h\ 23^m\ 43.1^s$
Decl. $+28°\ 1'\ 24''$.

Professor Lewis Swift first saw Tuttle's comet August 13th, unfavorable weather preventing an earlier search. It is fairly bright on a dark sky, and shows a strong condensation at the center.

Answers to interesting queries from a friend in Exeter, N. H., are deferred for want of space.

Much of interest concerning the new star must be dropped this month for want of space.

Brook's Comet.

The circumstances attending the discovery of this comet resembled in one respect that of Barnard's. The position of the latter at discovery was so close to a nebula as to raise a suspicion that it might be the nebula itself which caused a delay of a day in cabling to Europe in order that its cometary character might be certainly established. Brook's comet, however, instead of being near one nebula was near to five and in my telegraphic dispatch to Pickering announcing his discovery, I thought best to say "verify."

It may not be known to all of your readers that the discoverer of a comet must, in order to claim the Warner $200 comet prize, telegraph its discovery to me and to me only. Being then untramelled by a single doubt as to what announcements the discoverer had made, immediate notification by telegraph is made to Prof. Pickering, and, according to an arrangement between us, I am to say "Cable" if after a thorough examination of all the circumstances, it is considered almost certain that the object seen is a comet. If some doubt arises I am to say "verify". If neither word is used it indicates that the cometary character of the object is considered doubtful, but desire Prof. Pickering to share with me the responsibility of withholding it for confirmation. The scheme thus far has worked well, and renders a false alarm less probable At most the delay would amount to but a day, as the discovery could be verified at some one of the many observatories in the United States.

It is important that discoverers in their telegrams to me should use one of the three following terms expressive of motion, viz: motion suspected; motion strongly suspected; motion certain. LEWIS SWIFT.

Warner Observatory, September 8, 1885.

Comet A 1885 [Barnard.]

The following observations have been made with the 6-inch Cook equatorial of this observatory. The first observation was obtained by three differences of right ascension and two estimations for difference of declination, the comet being too faint to be seen on the ring.

The rest have been obtained with ring micrometer. The comet has also been observed on July 30th, 31st, and August 3rd, 4th, 5th, 8th, 12th, and probably on 13th, but the comparison stars have not yet been found in the catalogue. I wish to acknowledge the kindness of Messrs. S. C. Chandler Jr. and H. V. Egbert, of Harvard and Dudley observatories, in supplying the places of work of the comparison stars used in these observations. The star h, was observed specially by Mr. Egbert.

E. E. BARNARD.

Vanderbilt University Observatory, Nashville Tennessee.

Longitude		$+39^m$ 0.68^s	from Washington.
Latitude	$+36°$	8.5′ 8.25″	

OBSERVATIONS OF COMET A 1885 [BARNARD] MADE WITH THE 6-INCH EQUATORIAL OF VANDERBILT UNIVERSITY OBSERVATORY.

Nashville mean time 1885.					$\Delta\alpha$ c—s	$\Delta\delta$ c—s	No. of comps.	Apparent α	Apparent δ	Stars.	Remarks.
	d	h	m	s	m s	′ ″		h m s	° ′ ″		
July	7	14	35	37	+0 48.70	−1 50.0	3	17 21 23.53	−4 57 4.0	a	Wet clouds forming in west. Comet faint, could not observe on ring.
"	8	12	16	7	−0 21.99	−8 52.5	7	17 19 40.56	−5 27 39.6	b	Small and dim with very small ill-defined nucleus No tail.
"	8	12	16	7	−2 56.74	+4 53.3	7	17 19 40.60	−5 27 36.9	c	Both stars used at same observation of comet.
"	10	11	31	4	−3 54.41	−6 47.8	7	17 15 56.91	−6 35 27.2	d	There is an ill-defined brightening in the middle to a tiny nucleus.
"	15	10	35	30	−0 22.04	−15 43.0	12	17 7 0.46	−9 24 18.7	e	Dim and hazy. There seems to be considerable but indefinite condensation.
"	29	8	51	14	−3 5.41	−10 29.7	8	16 46 20.74	−16 47 45.6	f	Occasionally indefinite brightening near center. Comet very faint. Moon near rising.

COMPARISON STARS.

Star	Mean α 1885			Reduction to apparent place	Mean δ 1885			Reduction to apparent place	Authority.
	h	m	s	s ′	°	′	″	″	
a	17	20	31.90	+2.93	— 4	59	3.6	+9.5	Yarnall 7244
b	17	19	59.63	+2.92	— 5	18	56.5	+9.4	H. V. Egbert, Dudley Observatory.
c	17	22	34.12	+2.92	— 5	32	39.6	+9.4	Weisse's Bessel. The star is west 47h 365.
d	17	19	48.38	+2.94	— 6	28	47.6	+8.2	5816 of Rumker's Catalogue of 12,000 stars.
e	17	7	19.55	+2.95	— 9	8	43.9	+8.2	Schj. 6146. This star is taken from A. N. 2674.
f	16	49	23.23	+2 92	—16	37	21.3	+5.4	½ (Yarnall 7008 + Rumker 5585 + Stone [?])

Professor JOHN, of De Pauw University has in place in the new McKINN observatory a 9½-inch equatorial. The mounting of the telescope and the dome of the observatory which is 17 feet in diameter were made by Messrs. WARNER & SWASEY, Cleveland, Ohio, whose excellent work is attracting wide and favorable attention. Professor JOHN will soon give us a full description of this new observatory.

The following orders and subscriptions have not been previously acknowledged:

Levi K. Fuller, Brattleboro, Vermont. F. M. Bookwalter, Springfield, Ohio, (Vols. 3 and 4). Maryland Institute, Baltimore, Maryland. Isaac P. Guildenschuk, 14 Achilles St., Rochester, New York. R. Rother, 238 Randolph Street, Detroit, Michigan. Charles A. Hiller, Salina, Kansas. Wm. A. Haren, 1300 Hickory Street, St. Louis, Missouri. Lawrence Oberliss, Rochester, New York. Rev. S. G. McFarland, Bangkok, Siam, Asia (via San Francisco). Lewis H. Roberts, Clinton, Iowa. Simeon G. Cole, Romeo, Michigan. Professor M. B. Snyder, Central High School observatory, Philadelphia, Pennsylvania. M. A. Newell, Principal State Normal School, Baltimore, Maryland. John Goldie, Galt, Ontario, Canada. State Normal School, Winona, Minnesota. A Bassett, Bannock City, Montana. Reading Room, State Normal School, Winona, Minnesota. Samuel B. Eason, Wooster, Ohio. Professor M. A. Newell, State Normal School, Baltimore, Md. State Normal University, Normal, Illinois. N. H. Campbell, Pine State Normal School, Johnson, Vt. R. C. Wilkins, Northfield, Minn. G. W. McGinnis, State Normal School, Kirkville, Mo. (Vols. 3 and 4). Frank Drummond, Lamori, Iowa. W C. Pond, Hartford, Conn. Library, Harvard College, Cambridge, Mass. W. H. Klingfelter, Woodbridge, California. Rev. Dr. Williamson, Queen's University, Kingston, Canada. Israel Brundage, Pastor of First Presbyterian Church, Rochelle, Ill. J. C. McClure, Red Wing, Minn. Abraham Cooper, Zanesville Ohio. Bert Luty, Alleghany City, Pa. Rev. Thomas Thomas, Trenton, Oneida Co., N. Y. Professor Frank H. Bigelow, Racine College, Racine, Wis. Reading Room of West Virginia University, Morgantown, West Va. Professor C. S. Howe, Buchtel College, Akron, Ohio. Library of Mechanics Institute, San Francisco, Cal. Dr. J. H. Wythe, Oakland, Cal. C. H. Stegman, Oakland, Cal. L. D. Hampton, Hampton College, Louisville, Ky. Normal Reading Room, State Normal School, Warrensburg, Mo. John M. Black, No. 1334, Chestnut Street, Philadelphia, Pa. A. S. Moore, McKinney, Texas.

XUM

The October Planets.

[Central Standard Time.]

Mercury rises October 5th, 17*h* 33*m*;
" " " 15th, 18*h* 26*m*;
" " " 24th, 19*h* 14*m*.

Venus sets October 5th, 7*h* 14*m*;
" " " 15th, 7*h* 7*m*;
" " " 25th, 7*h* 6*m*.

Mars rises October 5th, 15*h* 29*m*;
" " " 15th, 12*h* 40*m*;
" " " 25th, 12*h* 29*m*.

Jupiter rises October 5th, 16*h* 25*m*;
" " " 15th, 15*h* 57*m*;
" " " 25th, 15*h* 27*m*.

Saturn rises October 5th, 10*h* 9*m*;
" " " 15th, 16*h* 51*m*;
" " " 27th, 16*h* 8*m*.

Uranus rises October 7th, 17*h* 19*m*;
" " " 15th, 16*h* 51*m*;
" " " 27th, 16*h* 8*m*.

Neptune rises October 7th 7*h* 23*m*;
" " " 15th 6*h* 51*m*;
" " " 27th 6*h* 3*m*.

Book Notice.

A Treatise on Practical Astronomy as applied to Geodesy and Navigation. By C. L. Doolittle, Professor of Mathematics and Astronomy, Lehigh University, New York. Messrs. John Wiley & Sons, Publishers, 1885, pp. 642.

The author has aimed to prepare a text book for colleges and technical schools, which may also be used as a manual for the field astronomer, in Geodesy and Navigation.

The subjects of Least Squares and Interpolation are first considered, and deserved prominence given to them as themes introductory to the part designated as Practical Astronomy. Those students who have not read very much mathematics will find the discussion of Least Squares not at all tedious, as usual, but rather gratifying in the author's ready application of the theoretical side of the theme to common practical ends and to the best use of astronomical observations in particular lines of work.

Under the head of Practical Astronomy the first chapter treats of the celestial sphere and the transformation of co-ordinates, and the ordinary problems related thereto; the second discusses prallax, refraction, and the dip of the horizon; the third is devoted to time; the fourth, angu-

lar measurements, the sextant, the chronometer and the clock; the next to the determination of time and latitude, and methods adapted to the use of the sextant; the sixth gives a full study of the transit instrument; seven, determinations of longitude; eight, the zenith telescope; nine, determination of azimuth; and ten, precession, nutation, aberration and proper motion.

This book lays no claim to new or original methods, but presents, in systematic form, the most approved ones in actual use at the present time. For the range of work the author has chosen, the treatment of topics is always clear and concise, formulæ and mathematical work neatly in order, and the applications, instructive and general. The book makes no show of learning for its own sake in the treatment of its topics. It is not a treatise on Astronomy or Geodesy or Navigation as such, but it is a useful work in the study of the applications of Mathematics and Astronomy to the two important branches of scientific labor named in its title.

The publishers, as usual, have done their part neatly and well.

Books Received.

Memoirs of the Royal Astronomical Society, Vol. 48, Parts I and II, 1884.

Maderia Spectroscope, C. Piazzi Smyth, Edinburg, Scotland. 1881--2.

The fixed Idea of Astronomical Theory, by August Tischner, Leipsic

Observations upon the Topography and Climate of Crownborough Hill, Sussex, England.

Publications of the Washburn Observatory, Vol. III, Madison, Wis.

Report of Observations of the Total Eclipse of the *Sun*, August 7, 1869. Prof. J. H. C. Coffin, U. S. A.

Papers.

The orbits of *Oberon* and *Titania*, the outer satellites of *Mars* by Prof. A. Hall.

The orbit of the satellite of *Neptune* by Professor A. Hall.

Tornado Studies for 1884 by John P. Finley.

Heights of the stations of the Davidson Quadrilaterals from Trigonometrical Determinations by George Davidson, U. S. C. and G. Survey.

The Run of the Micrometer, also by Professor Davidson.

Papers read before the American Astronomical Society. (No. 1.)

Possibility of Errors in Scientific Researches due to Thought Transference, by Professor E. C. Pickering.

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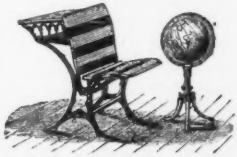

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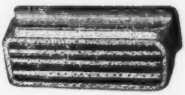

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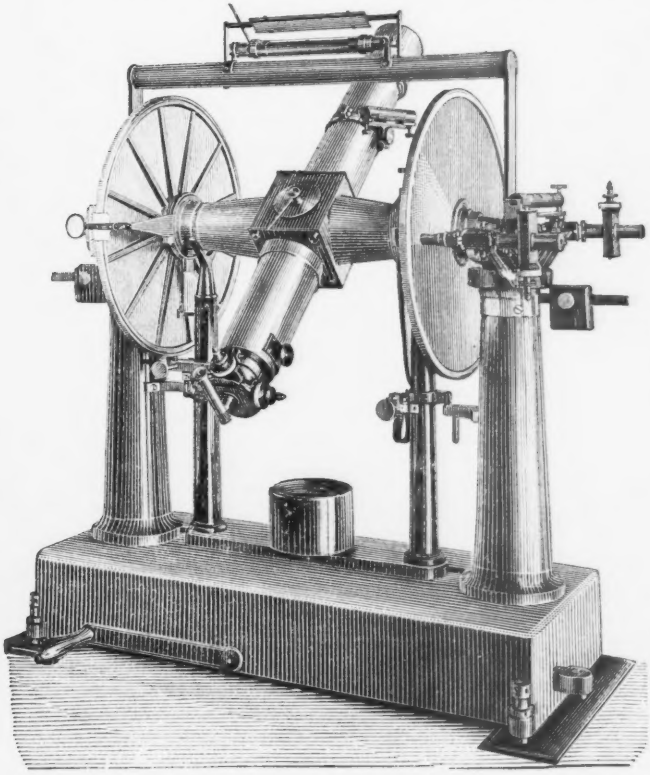

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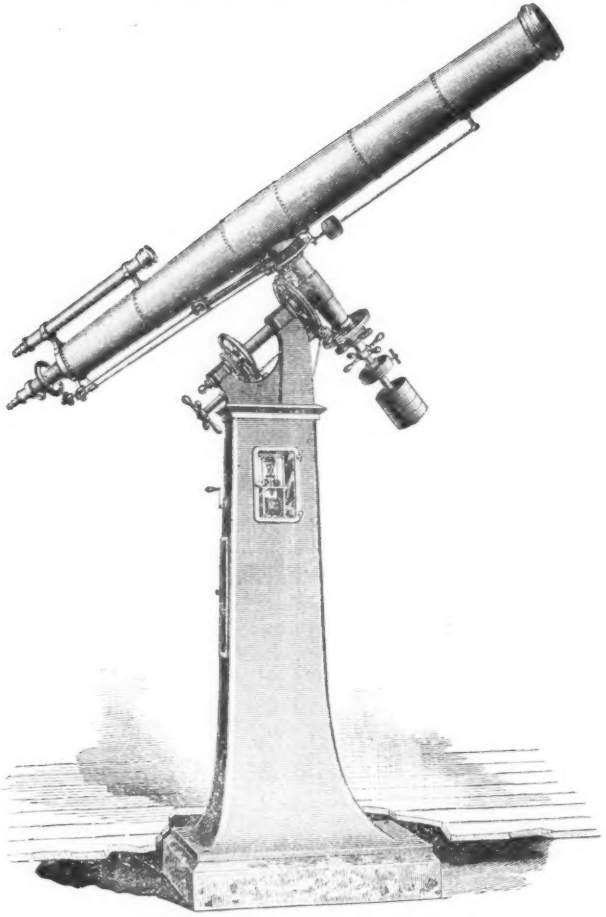

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